SEXUAL DIFFERENCES IN GROWTH OF THE PAINTED COMBER, *SERRANUS SCRIBA* (LINNAEUS, 1758) (TELEOSTEI, SERRANIDAE) FROM SOUTH EASTERN MEDITERRANEAN

by

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ABSTRACT. - Growth of Painted Comber, *Serranus scriba*, from Egyptian Mediterranean waters was studied for 568 females and 295 hermaphrodites. The two sexual phases grew at different rates. Hermaphrodites have a larger adult size, a longer life span, and reach sexual maturity at an earlier size than females. The von Bertalanffy's asymptotic growth function adequately describes Painted Comber's growth. Females, $L\infty = 26.86$ cm, $W\infty = 217$ g, $k = 0.2366$, $t_0 = -1.0181$; hermaphrodites, $L\infty = 33.18$ cm, $W\infty = 398$ g, $k = 0.2194$, $t_0 = -1.0159$. The index of growth performance (Q'), shows that the rate of growth is better in hermaphrodites than in females. The well-being of this species under natural conditions is also discussed.

RÉSUMÉ. - La croissance du Serran écriture, *Serranus scriba*, de la côte égyptienne a été étudiée sur 568 femelles et 295 hermaphrodites. Les deux phases sexuelles ont des rythmes de croissance différents. Les individus hermaphrodites ont tendance à être plus grands que les femelles, ils vivent plus longtemps et ils atteignent leur maturité sexuelle à un âge plus jeune que les femelles. Les paramètres de l'équation de von Bertalanffy ont été déterminés pour les hermaphrodites et les femelles. L'indice de performance de croissance (Q') montre que la croissance des hermaphrodites est plus rapide que celle des femelles.

Key-words.- Serranidae, *Serranus scriba*, MED, Hermaphrodism, Growth performance.

Fishes of family Serranidae are among the economically important marine fishes in the Egyptian Mediterranean waters. They represent a substantial portion of the Egyptian catch (19.26%).

The literature on the biology of Painted Comber is limited to information on the hermaphroditism. Various authors, however, have reported synchronous functional hermaphroditism in this species in which an individual has functional ovaries and functional testes concurrently (Dufossé, 1956; Reinboth, 1962; Smith, 1965; Fishelson, 1975; Abdel-Aziz and Ramadan, 1990).

The purpose of the present study is to secure information on the growth pattern of females and hermaphrodites of *S. scriba* as a contribution to a better understanding of the biology of this species.

MATERIAL AND METHODS

Monthly samples of *Serranus scriba* were taken from the commercial trawl catch from the Eastern Harbour at Anfoushy, Alexandria, from January to December 1990 (568 females and 295 hermaphrodites). For each fish, total length

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in cm and total body weight in g were recorded. Scale samples from below the lateral line and behind the pectoral fin were mounted dry on a glass slide for age determination. Scale examination and measurements were carried out under a binocular microscope at a magnification of x40. Scale measurements included: the distance from the focus to each annulus at the edge of the anterior field, the distance from the last annulus to the margin, and the scale radius.

Females and hermaphrodites were identified according to the anatomical and histological examination of their gonads (Abdel-Aziz and Ramadan, 1990). Hermaphrodite gonad has the same appearance as the female gonad. It is predominantly ovarian, with the male tissue as two patches confined to the posteroventral region (Fig. 1a,b).

Total length/scale diameter (L/S) relationship was determined by the least square method (Lagler, 1956). Back calculation of total length was done according to Lee (1920). Length/weight relationship was studied according to Le Cren (1951).

The theoretical growth in length and weight of *S. scriba* were calculated by von Bertalanffy's growth equations (von Bertalanffy 1938). Ford-Walford's method was used to estimate the parameters $L\infty$ (maximum expected length) and k (growth coefficient) of the VBGE (Ricker, 1975). Correspondingly value t_o (theoretical age at zero size) was calculated separately by the method proposed by Gulland (1964). For the sake of comparison, growth performance of sexual phases ($Q' = \log k + 2 \log L\infty$) was assessed according to Moreau *et al.* (1986). The value of maximum age (tmax) which is the measure of the longevity was determined according to Pauly (1983).

RESULTS

Scale examination

The scales of *Serranus scriba* are ctenoid and strongly imbricated in the skin. Annular markings are well defined except in old fish (age groups VI-VIII) where the annuli become crowded and difficult to distinguish. Hermaphrodites have relatively larger scales than females of the same size and taken from the same region (Fig. 2a,b).

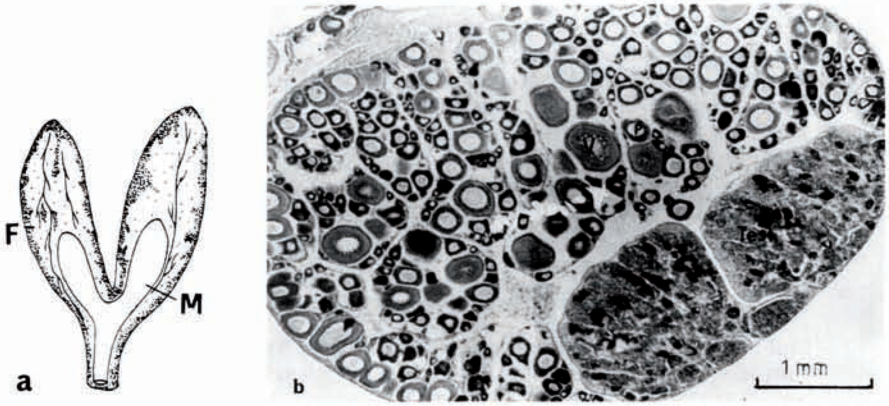

Fig. 1. - (a) Sketch of the posteroventral region of hermaphrodite gonad. M = male part; F = female part. (b) Transverse section of hermaphrodite gonad of *Serranus scriba*. P = previtellogenic oocyte; V = vitellogenic oocyte; Test. = testicular part. Scale bar = 1 mm.

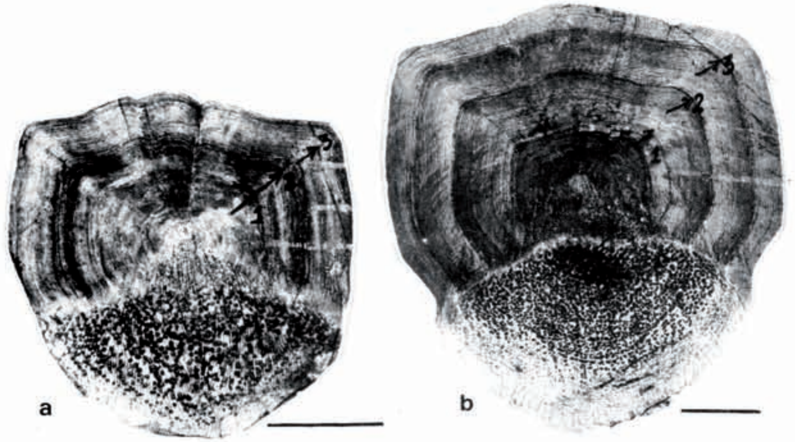

Fig. 2.- Scales from behind the pectoral fin of *Serranus scriba*. a- Female (Age 3+); b- Hermaphrodite (Age 3+). Scale bar = 1 mm.

Table I.- Monthly increment of length (mm) at age group III of *Serranus scriba* (parentheses indicate the number of individuals).

Month	**Hermaphrodites**	**Females**
January	3.30 ± 2.2 (13)	2.52 ± 3.2 (16)
February	3.42 ± 2.6 (10)	1.98 ± 4.1 (12)
March	2.08 ± 0.7 (23)	1.43 ± 5.2 (10)
April	1.50 ± 3.0 (12)	1.68 ± 5.1 (22)
May	1.89 ± 6.0 (14)	1.96 ± 6.0 (11)
June	2.69 ± 9.0 (9)	2.61 ± 7.0 (9)
July	3.11 ± 11.1 (22)	2.25 ± 9.1 (14)
August	3.16 ± 8.0 (18)	2.27 ± 10.0 (22)
September	3.95 ± 3.0 (11)	2.43 ± 8.0 (21)
October	3.71 ± 6.0 (26)	3.11 ± 6.2 (16)
November	4.02 ± 8.0 (10)	3.01 ± 13.0 (18)
December	3.61 ± 2.4 (12)	2.74 ± 15.0 (11)

To determine the time of annulus formation, the mean monthly marginal increments from the last ring to the margin of the scale were recorded to age group III of female and hermaphrodite individuals of *S. scriba* (Table I). It was found that the lowest mean marginal increment for female of *S. scriba* was shown in March, while that of hermaphrodites in April. This reveals that for *S. scriba* the annulus was formed during spring (March to April).

Growth in length

The relationships of total length (L) to scale radius ($S \times 40$) obtained from females and hermaphrodites were $L = 2.735 + 2.233\ S$ and $L = 1.1855 + 2.002\ S$, respectively. The correlation coefficients for the two equations were 0.99 and 0.96, respectively. Covariance analysis revealed a significant difference in the value of b in the two body-scale relationships, for females and hermaphrodites where the value of F was $= 16.24$, $df = 2017$ and $P < 0.05$ (where b = slope of the regression line; F = frequency; df = degree of freedom; P = level of significance).

The estimation of annual growth increment in length was based on back calculated lengths. It appears from table II and figure 3 that females and hermaphrodites attained 46.8 and 41.8% of their maximum adult size during the first year of life. After the completion of the first year, the annual growth increment was rapidly reduced and remained at values of 12.9-6.6% of the maximum length in the females (age groups I-VI) and of 16.3-4.2% in the hermaphrodites (age groups I-VIII).

Growth in weight

The length-weight relationship was used for the estimation of growth in weight of *Serranus scriba*. The statistics for the least square linear regression were: $\log Wt = -1.913 + 2.973 \log TL$, $r = 0.984$ for females; $\log Wt = -1.529 + 2.715 \log TL$, $r = 0.871$ for hermaphrodites.

Table II. - Back calculated length (cm) of *Serranus scriba*. F = females; H = hermaphrodites.

Age (years)	Sex	Number of fish	Average length (cm)	Standard deviation	Annual increment	% annual increment
I	F	202	10.01	12.3	10.01	46.82
	H	17	12.01	11.1	12.01	41.83
II	F	112	13.70	14.6	3.69	12.90
	H	49	16.68	11.5	4.67	16.27
III	F	186	16.22	13.7	2.52	11.65
	H	66	19.96	13.3	3.28	11.42
IV	F	52	18.44	12.8	2.22	10.26
	H	56	22.14	6.4	2.18	7.59
V	F	12	20.21	3.0	1.77	8.18
	H	40	24.13	7.8	1.99	6.93
VI	F	4	21.63	9.2	1.42	6.56
	H	34	25.91	5.9	1.78	6.20
VII	F	-	-	-	-	-
	H	27	27.50	10.4	1.59	5.54
VIII	F	-	-	-	-	-
	H	6	28.71	11.1	1.21	4.21

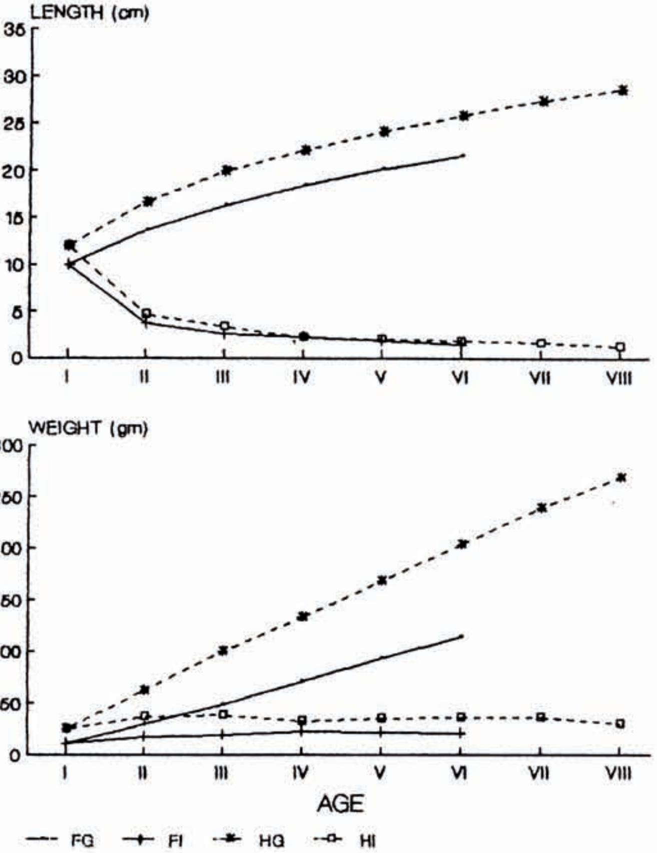

Fig. 3. - Growth and weight curves in females (—) and hermaphrodites (---) of *Serranus scriba*. FG, FI = female growth and female increment; HG, HI = hermaphrodite growth and increment.

The covariance analysis revealed significant differences in allometric growth rates between females and hermaphrodites. $F = 24.67$; $df = 1618$; $P < 0.05$.

The annual growth increment in weight was minimum during the first year (10.1% for females and 9.4% for hermaphrodites). This annual increment increased slowly reaching a maximum value of 14.4% for hermaphrodites and 19.7% for females in the 3rd and 4th years, respectively (Table III, Fig. 3).

Theoretical growth

The growth parameters of VBGF are shown in table IV, for females and hermaphrodites. It is clear that the value of $L\infty$ and $W\infty$ were higher for hermaphrodites than for females, while the value of k, which is the catabolic index was higher for females than for hermaphrodites. The index of growth performance (Q') was assessed using the von Bertalanffy growth parameters (k and $L\infty$). Thus it is clear from table IV that the hermaphrodites have better growth than females. In general, *Serranus scriba* is a slow growing fish with moderate life span, where females had a maximum age of 11.7 years and $k = 0.237$ and hermaphrodites had a maximum age of 12.7 years and $k = 0.219$ (Table IV).

Table III. - Back calculated weight (g) of *Serranus scriba*.

Age (years)	Sex	Number of fish	Average weight (g)	Standard deviation	Annual increment	% annual increment
I	F	202	11.52	1.7	11.52	10.12
	H	17	25.23	2.9	25.23	9.38
II	F	112	29.27	3.8	17.75	12.95
	H	49	61.55	2.1	36.32	13.51
III	F	186	48.36	5.2	19.09	16.78
	H	66	100.22	4.6	38.67	14.38
IV	F	52	70.81	6.6	22.45	19.73
	H	56	132.79	7.8	32.57	12.11
V	F	12	92.99	8.1	22.18	19.49
	H	40	167.74	9.2	34.95	11.99
VI	F	4	113.79	10.4	20.80	18.28
	H	34	203.50	9.0	35.76	13.30
VII	F	-	-	-	-	-
	H	27	239.21	10.2	35.71	13.28
VIII	F	-	-	-	-	-
	H	6	268.88	13.21	29.67	11.03

Table IV. - Theoretical growth parameters of *Serranus scriba*. L_∞ = asymptotic length; W_∞ = corresponding weight; k = growth coefficient; t_o = theoretical age at zero size; tmax = longevity; Q' = index of growth performance.

Parameters Sex	L_∞ (cm)	W_∞ (g)	k (cm)	t_0 (years)	t_{max} (years)	Q'
Females	26.86	216.63	0.2366	- 1.0181	11.66	2.232
Hermaphrodites	33.18	398.33	0.2194	- 1.0159	12.66	2.393

DISCUSSION

In Egyptian Mediterranean waters, the local population of Painted Comber, *Serranus scriba* comprises 67% females, 31% hermaphrodites and 2% males (Abdel-Aziz and Ramadan 1990). Ezzat *et al.*, (1988) mentioned that the local population of *S. cabrilla* in Egyptian Mediterranean waters comprises females and hermaphrodites. Pure males were never recorded.

According to the present results, growth in length for *S. scriba* was higher in the first year and decreased afterwards. It ranged between 12.9 and 6.6% in females (age groups I-VI) and between 16.3 and 4.2% in hermaphrodites (age groups I-VIII). Ponderal growth rate was least in the first year and increased annually afterwards. It reached maximal values in the third and fourth years in hermaphrodites and females, respectively. Similar variations in ponderal and linear growth rates with age have been reported before by various authors (Lagler, 1956; Nikolsky, 1963).

Estimation of VBGF parameters, revealed that $L\infty$ and $W\infty$ were 26.86 cm and 216.63 g for females and 33.18 cm and 398.33 g for hermaphrodites, while k was 0.2366 for females and 0.2194 for hermaphrodites. It is known that the values of $L\infty$ and $W\infty$ reflect good food supply, while k is a function of catabolic processes which are in turn directly related to environmental factors (Pauly, 1979).

Growth comparisons of fish based on a single parameter (k or $L\infty$ or $W\infty$) have been found to be misleading (Pauly, 1979; Moreau *et al.*, 1985). Several authors have proposed indices of overall growth performance based on two parameters (k and $L\infty$) (Pauly, 1979; Pauly and Munro, 1984). Moreau *et al.* (1986) found that the best index, i.e. the one which distribution was most similar to a normal distribution, was Q' ($= \log k + 2 \log L\infty$). Based on the index Q' we can see that hermaphrodites have better growth rates than the females.

The present data show that hermaphrodite individuals of *S. scriba* have better growth rates, reach larger sizes and have a longer life span than females. Moreover, Abdel-Aziz and Ramadan (1990) mentioned that hermaphrodite individuals of this species start maturity one month earlier than the females. This suggests the possibility of cross breeding between hermaphrodite and female individuals. Abdel-Aziz and Ramadan (1990) found that pure males were sexually inactive and do not take part in the reproductive act. Self fertilization have been experimentally demonstrated in *Serranus* by Dufossé (1956) and Reinboth (1967).

That hermaphrodites are bigger in size, longer in life span and reach sexual maturity earlier than females, is a way to ensure the well-being of this species, and increases the recruited individuals to the population. Robinson (1979) reported that the advantage of sex reversal of *Chrysoblephus cristiceps*, in that the younger reproductive sector of the population could avoid their natural predators, while the larger slower males would have the potential of fertilizing several females.

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